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THE DEVELOPMENT OF A HIGH AVERAGE POWER GLASS LASER SOURCE.(U)
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The Development of a High Average Power Glass Laser Source LEVEL II

Progress Report

Contract N00014-81-C-2376
September 30, 1981

Kigre Inc.,
Toledo, OH

Subject: NRL Contract N00014-81-C-2376

Reference: An Unsolicited Proposal for the Development of a High Average Power Glass Laser Source, Dated July 1, 1981

During September, 1981, the majority of the effort expended was concerned with the tailoring of the pump-window filter and the acquisition of the necessary re-draw equipment. We are also submitting a special report, prepared by Dr. C. F. Rapp, on the fluorescent pumping aspects of the filter development.

The specific activities occurring are delineated per their respective task as follows:

Task 1; Q-100 Property Measurements

No activity

Task 2; The Cladding of Q-100

Delivery has been accepted on the Model CW-190-MPX annealer from Blue M plus the re-draw tower and furnace assembly from Jerl Machinery. Concerns regarding the ability to uniformly pump the active core of the clad material have prompted experiments to assure the proper neodymium concentration for three to five millmeter core diameters. These experiments were conducted by grinding down the center portion of standard 1/4" x 3 1/4" test rods of varying neodymium concentrations. The central 2 1/2 inches of each rod was reduced to 4mm diameter. The rods were then pumped in a standing water-cooled laser cavity, using reflectors of 100% and 55%. Plastic Q-switches of different optical densities were then placed in the cavity and the output burn pattern analyzed for indication of non-uniform pumping. In this manner, the optimum doping levels for 3 to 5mm diameter laser rods were determined. These measurements are the basis for determining the optimum doping for the active core in the clad laser rods.

Task 3; Selective Filtering And/Or Energy Transfer to Reduce Thermal Loading

Examination and analyst of the absorption spectra of the various rare-earth ions in glass have resulted in a first choice of a candidate pump-window filter material.

The criteria for selection included the following basic considerations:

1. The rare-earth ion should not absorb so as to overlap with the neodymium pump bands.
2. The amount of rare-earth used should be commensurable with concentration quenching limits to provide maximum fluorescence.

A spectrograph illustrating the filtering effort of L-341 versus the neodymium absorption is attached.

A pump cavity is being constructed of L-341. Performance will be compared with the standard KF-2 cavity both with respect to overall efficiency, (to determine if any significant fluorescent pumping occurs) and with respect to maximum average power-generation to determine effective concentration levels. L-341 is doped with the following rare-earth oxides.

Eu_2O_3
Tb_2O_3
CeO_2
Sm_2O_3

Analysis of desirable absorption levels for the filter material would indicate mean optical densities greater than 1.2 cm^{-1} might be necessary to radically effect the thermal loading of the laser rod. This analysis ignores any possible fluorescent pumping effects.

Task 4; Glass Strengthening

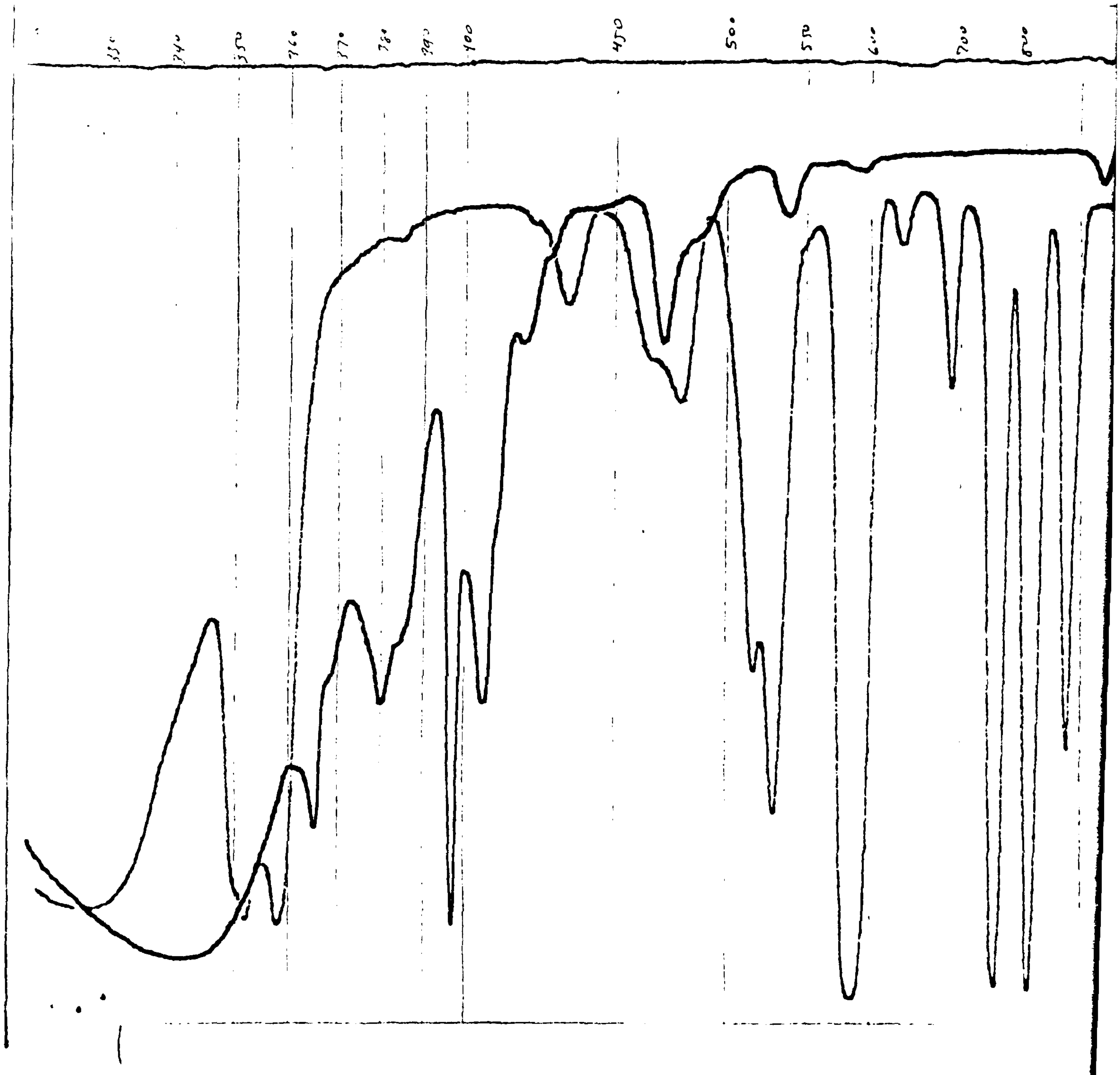
An article published in the Soviet Journal of Quantum Electronics[1] claims that "heat treatment (thermal tempering) increases the average power omitted by glass lasers while maintaining high emission brightness". Thermal tempering techniques are being reviewed to ascertain if similar experiments can be tried with Q-100.

Task 5; Alternate Pump Sources

No activity

Reference:

1. "Characteristics of Lasing In Heat-Treated Active Elements", V. M. Mit'kin Sov. J. Quantum Electronics 11 (3), March 1981



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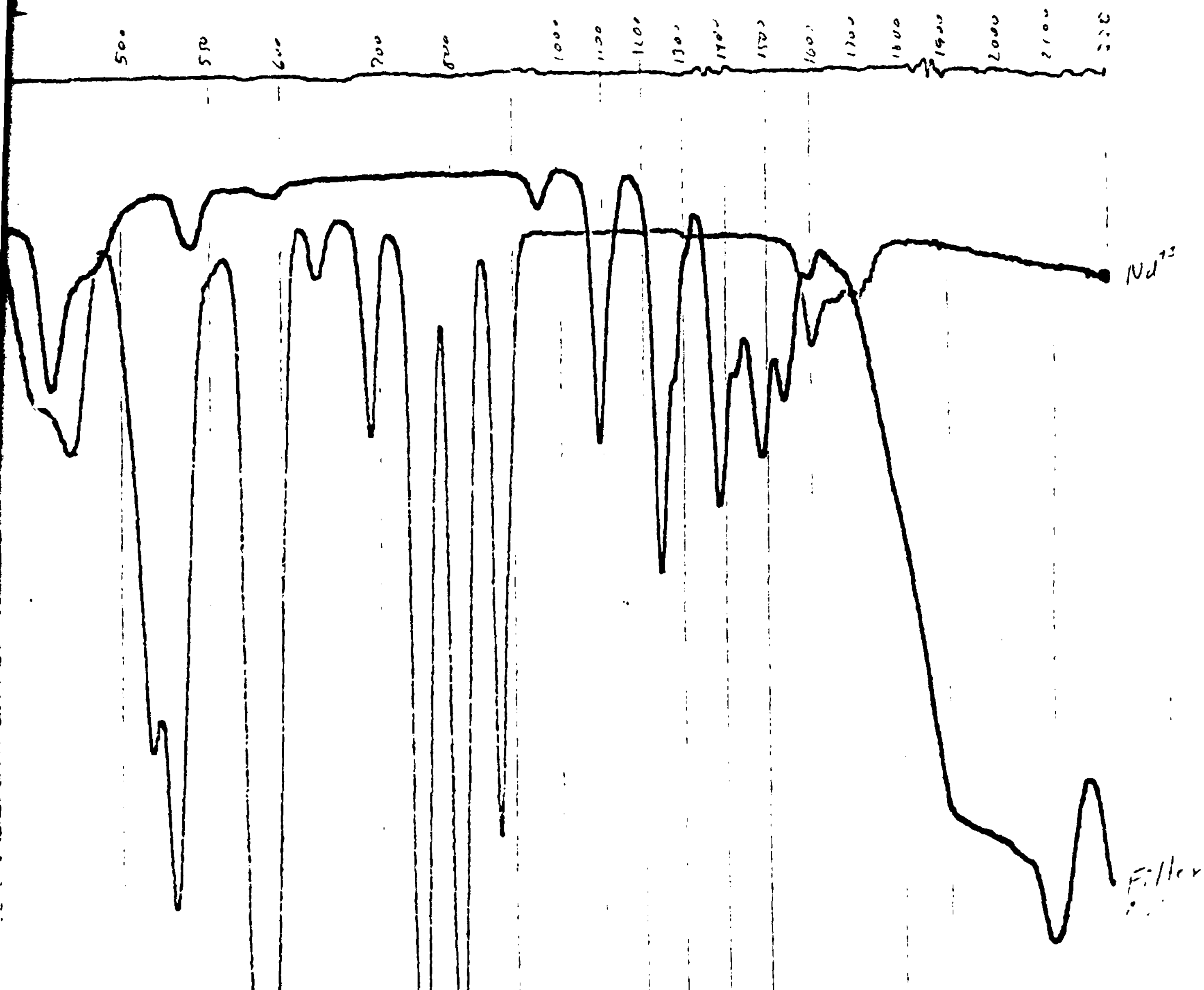

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